## IN THE CLAIMS

**Please amend the claims as follows:**

1. (Currently Amended): A method of monitoring a processing system for processing a substrate during the course of semiconductor manufacturing, comprising:

acquiring initial data from said processing system for a plurality of observations from a first set of substrate runs having performed a process in the processing system, said initial data comprising a plurality of data parameters;

constructing a principal components analysis (PCA) model from said data parameters of the first set, said PCA model including centering coefficients for the initial data from the first set;

acquiring additional data from said processing system after said constructing step from a second set of substrate runs performing said process in the processing system, said additional data comprising an additional observation of said plurality of data parameters;

adjusting said centering coefficients at the time of each observation of the additional data from the second set by utilizing both said initial data and current data obtained from the additional observation from the process performed in the second set to produce updated adaptive centering coefficients for each of said data parameters in said PCA model;

applying said updated adaptive centering coefficients to each of said data parameters in said PCA model created from the first set of substrate runs and unchanged;

determining at least one statistical quantity using a combination of said PCA model and the additional data that has been centered by the updated adaptive centering coefficients;

setting a control limit for said at least one statistical quantity;

comparing said at least one statistical quantity to said control limit in order to determine if the substrate processing remains within control during the course of semiconductor manufacturing for the second set; and

providing an output assessing the process being performed in the processing system.

2. (Previously Presented): The method of claim 1, wherein said adjusting said centering coefficients comprises:

combining an old value of the adaptive centering coefficient for each data parameter and the current value of each data parameter for said additional observation, wherein said old value of the adaptive centering coefficient comprises a mean value of the data parameters obtained during said plurality of observations in the step of acquiring initial data from said processing system.

3. (Original): The method of claim 2, wherein said combining said old value of said adaptive centering coefficient and said current value of said data parameter for said additional observation comprises:

applying an exponentially weighted moving average (EWMA) filter.

4. (Original): The method of claim 3, wherein said applying said EWMA filter comprises:

setting a weighting factor.

5. (Original): The method of claim 4, wherein said setting said weighting factor comprises:

setting said weighting factor to a value ranging from 0.5 to 1.0.

6. (Original): The method of claim 5, wherein said setting said weighting factor comprises:

setting said weighting factor to a value ranging from 0.8 to 0.95.

7. (Previously Presented): The method of claim 1, wherein said applying said updated adaptive centering coefficients to each of said data parameters comprises:

subtracting said updated adaptive centering coefficients from each of said data parameters.

8. (Previously Presented): The method of claim 1, further comprising:

determining scaling coefficients for the PCA model;

adjusting the scaling coefficients to produce updated adaptive scaling coefficients for each of said data parameters in said PCA model; and

applying said updated adaptive scaling coefficients to each of said data parameters in said PCA model, wherein the determining at least one statistical quantity uses said additional data that has also been scaled by the updated adaptive scaling coefficients.

9. (Previously Presented): The method of claim 8, wherein said adjusting said scaling coefficients comprises:

applying a recursive standard deviation filter, said filter combining an old value of the adaptive scaling coefficient for each data parameter, a current value of each data parameter for said additional observation, and an old value of the adaptive centering coefficient for each data parameter,

wherein said old value of said adaptive scaling coefficient comprises a standard deviation of said data parameter during said plurality of observations and said old value of said adaptive centering coefficient comprises a mean value of said data parameters obtained during said plurality of observations in the step of acquiring initial data from said processing system.

10. (Original): The method of claim 9, wherein said applying said recursive standard deviation filter comprises setting a filter constant.

11. (Original): The method of claim 1, wherein said applying said updated adaptive scaling coefficients to each of said data parameters comprises dividing each of said data parameters by said updated scaling coefficients.

12. (Previously Presented): The method of claim 1, wherein said constructing said PCA model comprises:

determining one or more principal components of said initial data for said plurality of observations using principal components analysis.

13. (Original): The method of claim 1, further comprising:

detecting a process fault has occurred when said at least one statistical quantity exceeds said control limit.

14. (Original): The method of claim 1, wherein said plurality of data parameters comprises at least one of a capacitor position, a forward radio frequency (RF) power, a reflected RF power, a voltage, a current, a phase, an impedance, a RF peak-to-peak voltage, a RF self-induced direct current bias, a chamber pressure, a gas flow rate, a temperature, a backside gas pressure, a backside gas flow rate, an electrostatic clamp voltage, an electrostatic clamp current, a focus ring thickness, RF hours, a process step duration, focus ring RF hours, an optical emission spectrum, and RF harmonics

15. (Original): The method of claim 1, wherein said plurality of data parameters comprises at least one of an instantaneous value, a time average, a standard deviation, a third moment, a fourth moment, and a variance.

16. (Original): The method of claim 1, wherein said statistical quantity comprises at least one of a Q-statistic and a Hotelling $T^2$ parameter.

17. (Previously Presented): The method of claim 1, further comprising:

accessing at least one of said initial data, said additional data, said adaptive centering coefficients, said at least one statistical quantity, and said control limit via at least one of an intranet and an internet.

18. (Original): The method of claim 8, further comprising:

accessing said adaptive scaling coefficients via at least one of an intranet and an internet.

19. (Currently Amended): In a process control system including a principal components analysis (PCA) model for monitoring a processing system for processing a substrate during the course of semiconductor manufacturing, the improvement comprising:

an adaptive centering coefficient for a data parameter obtained during a current observation made after construction of a PCA model from a first set of substrate runs having performed a process in the processing system,

said adaptive centering coefficient combining an old value of said adaptive centering coefficient and a current value of said data parameter for said current observation from a second set of substrate runs performing said process in the processing system to produce at

each observation of data an updated adaptive centering coefficient, wherein said old value of said adaptive centering coefficient comprises a mean value of data parameters obtained during a plurality of observations preceding said current observation;

at least one statistical quantity determined using a combination of said PCA model created from the first set of substrate runs and unchanged and additional data acquired after construction of the PCA model that has been centered by the updated adaptive centering coefficients;

said updated adaptive centering coefficient implemented in the PCA model to provide, based on the statistical quantity, an improved process center for the substrate processing in order to update the substrate processing during the course of semiconductor manufacturing for the second set; and ~~by providing~~

said improved process center producing an output assessing the process being performed in the processing system.

20. (Original): The improvement of claim 19, wherein said combining said old value of said adaptive centering coefficient and said current value of said data parameter for said current observation comprises applying an exponentially weighted moving average (EWMA) filter.

21. (Original): The improvement of claim 20, wherein said applying said EWMA filter comprises setting a weighting factor.

22. (Original): The improvement of claim 21, wherein said setting said weighting factor comprises setting said weighting factor to a value ranging from 0 to 1.

23. (Original): The improvement of claim 22, wherein said setting said weighting factor comprises setting said weighting factor to a value ranging from 0.8 to 0.95.

24. (Previously Presented): The improvement of claim 19, wherein:

said adaptive centering coefficient is at least derived from an application of an exact recursive standard deviation formula, said formula combining an old value of the adaptive centering coefficient, a current value of each data parameter obtained for said current observation, and said old value of the adaptive centering coefficient,

wherein said old value of said adaptive centering coefficient comprises a standard deviation of said data parameter during a plurality of observations preceding said current observation and said old value of said adaptive centering coefficient comprises the mean value of said data parameters obtained during a plurality of observations preceding said current observation.

25. (Currently Amended): A processing system for processing a substrate during the course of semiconductor manufacturing, comprising:

a process tool; and

a process performance monitoring system coupled to said process tool and comprising a plurality of sensors coupled to said process tool and a controller coupled to said plurality of sensors and said process tool,

wherein said controller includes,

means for acquiring initial data from said plurality of sensors for a plurality of observations from a first set of substrate runs having performed a process in the processing system, said initial data comprising a plurality of data parameters,

means for constructing a principal components analysis (PCA) model from said data

parameters of the first set, said PCA model including centering coefficients for the initial data,

means for acquiring additional data from said plurality of sensors after construction of the PCA model from a second set of substrate runs performing said process in the processing system,

means for adjusting said centering coefficients at the time of each observation of the additional data by utilizing both previous run data from said initial data and current data obtained by the means for acquiring additional data to produce updated adaptive centering coefficients for each of said data parameters,

means for applying said updated adaptive centering coefficients to each of said data parameters in said PCA model created from the first set of substrate runs and unchanged,

means for determining at least one statistical quantity using a combination of said PCA model and the additional data that has been centered by the updated adaptive centering coefficients,

means for setting a control limit for said at least one statistical quantity,

means for comparing said at least one statistical quantity to said control limit in order to determine if the substrate processing remains within control during the course of semiconductor manufacturing for the second set; and

means for providing an output assessing the process being performed in the processing system.

26. (Previously Presented): The processing system of claim 25, wherein said means for adjusting said centering coefficients comprises:

means for combining an old value of the adaptive centering coefficient for each data parameter and a current value of each data parameter for said additional data, wherein said old value of the adaptive centering coefficient comprises a mean value of the data parameters

obtained during said plurality of observations by the means for acquiring data from said processing system.

27. (Previously Presented): The processing system of claim 25, further comprising:

means for determining scaling coefficients for the PCA model;

means for adjusting the scaling coefficients to produce updated adaptive scaling coefficients for each of said data parameters in said PCA model; and

means for applying said updated adaptive scaling coefficients to each of said data parameters in said PCA model.

28. (Previously Presented): The processing system of claim 27, wherein said means for adjusting said scaling coefficients comprises:

means for applying a recursive standard deviation filter to said adaptive scaling coefficients, said filter combining an old value of the adaptive scaling coefficient for each data parameter, a current value of each data parameter for said additional data, and an old value of the adaptive centering coefficient for each data parameter,

wherein said old value of said adaptive scaling coefficient comprises a standard deviation of said data parameter during said plurality of observations and said old value of said adaptive centering coefficient comprises a mean value of said data parameters obtained during said plurality of observations by the means for acquiring data from said processing system.

29. (Previously Presented): The processing system of claim 25, further comprising:

means for accessing at least one of said initial data, said additional data, said adaptive centering coefficients, said at least one statistical quantity, and said control limit.

30. (Original): The processing system of claim 29, wherein said means for accessing comprises at least one of an intranet and an internet.

31. (Previously Presented): The processing system of claim 27, further comprising:

means for accessing at least one of said initial data, said additional data, said adaptive centering coefficients, said adaptive scaling coefficients, said at least one statistical quantity, and said control limit.

32. (Original): The processing system of claim 31, wherein said means for accessing comprises at least one of an intranet and an internet.

33. (Currently Amended): A processing performance monitoring system to monitor a processing system for processing a substrate during the course of semiconductor manufacturing, comprising:

a plurality of sensors coupled to said processing system; and

a controller coupled to said plurality of sensors and said processing system, wherein said controller includes,

means for acquiring initial data from said plurality of sensors for a plurality of observations from a first set of substrate runs having performed a process in the processing system, said initial data comprising a plurality of data parameters,

means for constructing a principal components analysis (PCA) model from said data parameters of the first set, said PCA model including centering coefficients for the initial data,

means for acquiring additional data from said plurality of sensors acquired after construction of the PCA model from a second set of substrate runs performing said process in the processing system,

means for adjusting said centering coefficients at the time of each observation of the additional data by utilizing both previous run data from said initial data and current data obtained by the means for acquiring additional data to produce updated centering coefficients for each of said data parameters,

means for applying said updated adaptive centering coefficients to each of said data parameters in said PCA model created from the first set of substrate runs and unchanged,

means for determining at least one statistical quantity using a combination of said PCA model and the additional data that has been centered by the updated adaptive centering coefficients,

means for setting a control limit for said at least one statistical quantity,

means for comparing said at least one statistical quantity to said control limit in order to determine if the substrate processing remains within control during the course of semiconductor manufacturing for the second set; and

means for providing an output assessing the process being performed in the processing system.

34. (Previously Presented): The process performance monitoring system of claim 33, wherein said means for adjusting said centering coefficients comprises:

means for combining an old value of the adaptive centering coefficient for each data parameter and a current value of each data parameter for said additional data,

wherein said old value of the adaptive centering coefficient comprises a mean value of the data parameters obtained during said plurality of observations by the means for acquiring data from said processing system.

35. (Previously Presented): The process performance monitoring system of claim 33,

further comprising:

means for determining scaling coefficients for the PCA model;

means for adjusting the scaling coefficients to produce updated adaptive scaling coefficients for each of said data parameters in said PCA model; and

means for applying said updated adaptive scaling coefficients to each of said data parameters in said PCA model.

36. (Previously Presented): The process performance monitoring system of claim 35, wherein said means for adjusting said scaling coefficients comprises:

means for applying a recursive standard deviation filter to said adaptive scaling coefficients,

said filter combining an old value of the adaptive scaling coefficient for each data parameter, a current value of each data parameter for said additional observation, and an old value of the adaptive centering coefficient for each data parameter,

wherein said old value of said adaptive scaling coefficient comprises a standard deviation of said data parameter during said plurality of observations and said old value of said adaptive centering coefficient comprises a mean value of said data parameters obtained during said plurality of observations by the means for acquiring initial data.

37. (Previously Presented): The process performance monitoring system of claim 33, further comprising:

means for accessing at least one of said initial data, said additional data, said adaptive centering coefficients, said at least one statistical quantity, and said control limit.

38. (Original): The process performance monitoring system of claim 37, wherein said

means for accessing comprises at least one of an intranet and an internet.

39. (Previously Presented): The process performance monitoring system of claim 35, further comprising:

means for accessing at least one of said initial data, said additional data, said adaptive centering coefficients, said adaptive scaling coefficients, said at least one statistical quantity, and said control limit.

40. (Original): The process performance monitoring system of claim 39, wherein said means for accessing comprises at least one of an intranet and an internet.

41. (Currently Amended): A method of monitoring a first processing system for processing a substrate during the course of semiconductor manufacturing, comprising:

acquiring initial data from a processing system for a plurality of observations from a first set of substrate runs having performed a process in the processing system, said initial data comprising a plurality of data parameters;

constructing a principal components analysis (PCA) model from said data parameters of the first set, said PCA model including centering coefficients for the initial data;

acquiring additional data from said first processing system after constructing the PCA model from a second set of substrate runs performing said process in the processing system, said additional data comprises an additional observation of said plurality of data parameters;

adjusting said centering coefficients at the time of each observation of the additional data by utilizing both previous run data from said initial data and current data obtained from the additional observations to produce updated adaptive coefficients for each of said data parameters in said PCA model;

applying said updated adaptive centering coefficients to each of said data parameters in said PCA model created from the first set of substrate runs and unchanged;

determining at least one statistical quantity using a combination of said PCA model and the additional data that has been centered by the updated adaptive centering coefficients;

setting a control limit for said at least one statistical quantity;

comparing said at least one statistical quantity to said control limit in order to determine if the substrate processing remains within control during the course of semiconductor manufacturing for the second set; and

providing an output assessing the process being performed in the processing system.

42. (Original): The method of claim 41, further comprising:

determining scaling coefficients for the PCA model;

adjusting the scaling coefficients to produce updated adaptive scaling coefficients for each of said data parameters in said PCA model; and

applying said updated adaptive scaling coefficients to each of said data parameters in said PCA model.

43. (Withdrawn): A method for classifying a process fault occurring during a plurality of substrate runs in a processing system, comprising:

monitoring a plurality of data parameters from said processing system for each substrate run within said plurality of substrate runs;

identifying a fault substrate run, within said plurality of substrate runs using multivariate analysis, in which said process fault occurred;

selecting a first substrate run preceding said fault substrate run;

calculating a first plurality of mean values for each of said plurality of data parameters

during said first substrate run;

selecting a second substrate run following said fault substrate run;

calculating a second plurality of mean values for each of said plurality of data parameters during said second substrate run;

determining an absolute value of a plurality of differences between said second plurality of mean values and said first plurality of mean values for each of said plurality of data parameters;

calculating a plurality of standard deviations for each of said plurality of data parameters during at least one of said first substrate run and said second substrate run;

normalizing said plurality of differences by said plurality of standard deviations for each of said plurality of data parameters;

determining the largest value of said normalized differences; and

identifying the data parameter amongst said plurality of data parameters corresponding to said largest value of said differences.

44. (Withdrawn): The method of claim 43, wherein said calculating each of said first plurality of mean values for each of said plurality of data parameters during said first substrate run comprises:

combining a first old mean value for each data parameter and a current value of each data parameter for said first substrate run,

wherein said first old mean value comprises a mean value of the data parameter during a substrate run preceding said first substrate run, and said calculating each of said second plurality of mean values for each of said plurality of data parameters during said second substrate run comprises combining a second old mean value for each data parameter and a current value of each data parameter for said second substrate run,

wherein said second old mean value comprises a mean value of the data parameter during a substrate run preceding said second substrate run.

45. (Withdrawn): The method of claim 44, wherein said combining said first old mean value and said current value of said data parameter during said first substrate run and said combining said second old mean value and said current value of said data parameter during said second substrate run comprises:

applying an exponentially weighted moving average (EWMA) filter.

46. (Withdrawn): A method for classifying a process fault occurring during a plurality of substrate runs in a processing system, comprising:

monitoring a plurality of data parameters from said processing system for each substrate run within said plurality of substrate runs;

identifying a fault substrate run, within said plurality of substrate runs using multivariate analysis, in which said process fault occurred;

selecting a first substrate run preceding said fault substrate run;

calculating a first plurality of standard deviations for each of said plurality of data parameters during said first substrate run;

selecting a second substrate run following said fault substrate run;

calculating a second plurality of standard deviations for each of said plurality of data parameters during said second substrate run;

determining an absolute value of a plurality of differences between said second plurality of standard deviations and said first plurality of standard deviations for each of said plurality of data parameters;

calculating a plurality of mean values for each of said plurality of data parameters

during one of said first substrate run and said second substrate run;

normalizing said plurality of differences by said plurality of mean values for each of said plurality of data parameters;

determining the largest value of said normalized differences; and

identifying the data parameter amongst said plurality of data parameters corresponding to said largest value of said differences.

47. (Currently Amended): A computer readable medium containing program instructions for execution on a computer system, which when executed by the computer system, cause the computer system to perform substrate processing comprising:

acquiring initial data from a processing system for a plurality of observations from a first set of substrate runs having performed a process in a processing system, said initial data comprising a plurality of data parameters;

constructing a principal components analysis (PCA) model from said data parameters of the first set, said PCA model including centering coefficients for the initial data;

acquiring additional data from said processing system after constructing the PCA model from a second set of substrate runs performing said process in the processing system, said additional data comprising an additional observation of said plurality of data parameters;

adjusting said centering coefficients by utilizing both previous run data from said initial data and current data obtained from the additional observation to produce updated adaptive centering coefficients for each of said data parameters in said PCA model;

applying said updated adaptive centering coefficients to each of said data parameters in said PCA model created from the first set of substrate runs and unchanged;

determining at least one statistical quantity using a combination of said PCA model and the additional data that has been centered by the updated adaptive centering coefficients;

setting a control limit for said at least one statistical quantity;

comparing said at least one statistical quantity to said control limit in order to determine if the substrate processing remains within control during the course of semiconductor manufacturing for the second set; and

providing an output assessing the process being performed in the processing system.

48. (Currently Amended): A computer readable medium containing program instructions for execution on a computer system, which when executed by the computer system, cause the computer system to perform substrate processing comprising:

acquiring initial data from a second processing system for a plurality of observations from a first set of substrate runs having performed a process in a processing system, said initial data comprising a plurality of data parameters;

constructing a principal components analysis (PCA) model from said data parameters of the first set, said PCA model including centering coefficients for the initial data;

acquiring additional data from a first processing system after constructing the PCA model from a second set of substrate runs performing said process in the processing system, said additional data comprises an additional observation of said plurality of data parameters;

adjusting said centering coefficients by utilizing both previous run data from said initial data and current data obtained from the additional observation to produce updated adaptive centering coefficients for each of said data parameters in said PCA model;

applying said updated adaptive centering coefficients to each of said data parameters in said PCA model <u>created from the first set of substrate runs and unchanged</u>;

determining at least one statistical quantity using a combination of said PCA model and the additional data that has been centered by the updated adaptive centering coefficients;

setting a control limit for said at least one statistical quantity;

comparing said at least one statistical quantity to said control limit in order to determine if the substrate processing remains within control during the course of manufacturing for the second set; and

providing an output assessing the process being performed in the processing system.

49. (Withdrawn): A computer readable medium containing program instructions for execution on a computer system, which when executed by the computer system, cause the computer system to perform the steps of:

monitoring a plurality of data parameters from a processing system for each substrate run within said plurality of substrate runs;

identifying a fault substrate run, within said plurality of substrate runs using multivariate analysis, in which said process fault occurred;

selecting a first substrate run preceding said fault substrate run;

calculating a first plurality of mean values for each of said plurality of data parameters during said first substrate run;

selecting a second substrate run following said fault substrate run;

calculating a second plurality of mean values for each of said plurality of data parameters during said second substrate run;

determining an absolute value of a plurality of differences between said second plurality of mean values and said first plurality of mean values for each of said plurality of data parameters;

calculating a plurality of standard deviations for each of said plurality of data parameters during at least one of said first substrate run and said second substrate run;

normalizing said plurality of differences by said plurality of standard deviations for each of said plurality of data parameters;

determining the largest value of said normalized differences; and

identifying the data parameter amongst said plurality of data parameters corresponding to said largest value of said differences.

50. (Withdrawn): A computer readable medium containing program instructions for execution on a computer system, which when executed by the computer system, cause the computer system to perform the steps of:

monitoring a plurality of data parameters from said processing system for each substrate run within said plurality of substrate runs;

identifying a fault substrate run, within said plurality of substrate runs using multivariate analysis, in which said process fault occurred;

selecting a first substrate run preceding said fault substrate run;

calculating a first plurality of standard deviations for each of said plurality of data parameters during said first substrate run;

selecting a second substrate run following said fault substrate run;

calculating a second plurality of standard deviations for each of said plurality of data parameters during said second substrate run;

determining the absolute value of a plurality of differences between said second plurality of standard deviations and said first plurality of standard deviations for each of said plurality of data parameters;

calculating a plurality of mean values for each of said plurality of data parameters during one of said first substrate run and said second substrate run;

normalizing said plurality of differences by said plurality of mean values for each of said plurality of data parameters;

determining the largest value of said normalized differences; and

identifying the data parameter amongst said plurality of data parameters corresponding to said largest value of said differences.